proſequendi Invitationem tuam proficiſcuntur, libenter, ut opinor, videbis. Vale. Patavio. Kal. Jun. CIƆIƆCCXXXVII.

III. *The Imperfections of the common* Barometers, *and the Improvement made in them, by Mr.* Cha. Orme *of* Aſhby-de-la-Zouche *in* Leiceſterſhire, *where they are perfected and rectified; with ſome Obſervations, Remarks and Rules for their Uſe, by* Hen. Beighton, *F. R. S.*

AS we know nothing more wanting than a Theory of the Weather on Mechanic Principles; there does not ſeem any thing in all Philoſophy of more immediate Concern to us than the State of the Weather.

In order to which, a complete Hiſtory of the Weather is neceſſary, to deduce from thence ſuch Rules and Obſervations as may in ſome meaſure form ſuch a Theory: And it may be ſaid, that could we in any tolerable degree foretel, but by ſome ſmall Space of Time, the Change of the Weather, it would be of admirable Uſe to us, in thoſe Affairs on which the chief part of our Welfare and Subſiſtence depends.

It was from ſuch Conſiderations, that more than 20 Years ago I began, and have continued, to keep a *Diary* of the *Weather* (the ſix laſt Years of which I have here ſubjoin'd); but cannot think myſelf ſo well qualified as to form a juſt *Theory* upon them, though

I am not without Hopes they may have their Uſes, when they fall into more able Hands.

Yet I believe I may ſay, that from them, and the Obſervations I made by a new *Improvement* of the *Barometer*, (for the ſame Number of Years) I can generally foretel for a Day, or perhaps two, the Change, or what Continuance the Weather will have.

And although ſo many ingenious and curious Perſons, ſince the Invention of *Torricellius*'s *Barometer*, have been improving and endeavouring to bring that Machine to Perfection; yet notwithſtanding all their indefatigable Care and Pains, the Air that is interſpers'd and mix'd with all Fluids, (of which *Mercury* is eſteem'd one) has in ſome meaſure fruſtrated their Labours, and it has remain'd imperfect: For whilſt there are any ſmall Quantities or Particles of Air remaining in the *Quickſilver*, it will be conſtantly *riſing* in *hot* Weather, and *falling* in *cold*: Which really perverts the very End and Deſign of a *Barometer*, which ſhould ſhew the Preſſure of the *Air*, and foretel when either *fair* Weather or *Rain* is coming; inſtead whereof it is in a great meaſure a *Thermometer*, foretelling *Heat* inſtead of *fair*, and *Cold* inſtead of *Rain* and *ſtormy Weather*: And theſe Imperfections have all the various ſorts of *Barometers* (more or leſs) that have hitherto been invented.

The *Barometer* I am about to deſcribe, is not different in Form from ſome uſually made, it being of the *Diagonal* kind, from whence the more minute Alterations are more readily diſcovered: Of this Form many have been made by the late curious Operator Mr. *Patrick*, who has, in his way, well deſerv'd of the Curious; who, though he had done ſo much to-

wards

wards the proving the Weight of the Atmoſphere by which the *Mercury* in the Tube was ſuſtain'd, he himſelf did not believe it, but run into that Abſurdity of the *Funicular* Hypotheſis.

There is an Inconveniency or Imperfection in moſt, if not all, of thoſe *Diagonal Barometers*; for after ſome time, the various riſing and falling, and Changes of the Weather, of Heat and Cold, the ſmall Particles of *Air* that have been interſpers'd in the *Mercury*, have got together in a larger Maſs, as they will incline by Attraction, which will ſeparate the *Mercury*; and that Quantity of *Air* will be dilated by *Heat*, and contracted by *Cold*, ſo as to ſpoil the Deſign thereof.

Beſides, there is ſuch a Coheſion or Attrition of the *Mercury* to the *Tube*, (eſpecially in the ſmall ones) that after ſome time, the *Mercury* that is not truly cleans'd from its Droſs, and purg'd of all its *Air*, in remarkable Changes of the Weather will neither riſe nor fall. All which Embarraſment is taken off, and the Difficulties ſurmounted, in

Mr. Cha. Orme's *Improvements of the* Barometer, *by the Method following.*

Firſt, The *Quickſilver* is all purified from its Droſs and earthy Particles by Diſtillation; and when the *Tube* is filled by a Pound and half, two, or three Pounds of *Mercury*, and all the *Air* got out by the Methods uſed in filling *Tubes*, then the remaining *Air* is got out by ſuch an *intenſe Heat* of *Fire* as makes the *Mercury boil*; by which Ebullition an innumerable Quantity of ſmall Particles are emitted, and blow with a great Velocity at the open End of the *Tube*, till all the

the *Air* is quite cleared out; which curious as well as fatiguing Operation is continued for the Space of four Hours: And when no more Bubbles would riſe in the *Tube*, it remain'd whole, with its *Mercury* of a moſt lively ſparkling Brightneſs, with this Difference only, that the *Mercury*, ſo purged from its *Air*, did not *fill* the *Tube* ſo high as when firſt put in by about two *Inches*; which is a plain Demonſtration, that in that *Tube*, which was 49 *Inches long*, there was interſpers'd in the *Mercury* at firſt filling it, ſo much *Air* as would fill *two Inches* of the ſaid *Tube*, which was a 24th Part of the ſaid Space.

The whole Operation I myſelf attended the 20th of *January* 1734-5.

And further I can affirm, that every Part of the *Mercury boiled* for a long time, and the *Tube* was *gradatim* ſo *red-hot*, that with a warm Knife I could make Impreſſions in any part of it.

And this I the rather mention, by reaſon I have heard ſeveral Perſons, and thoſe not incurious, affirm it was impoſſible.

And that this is the moſt ſure and certain (if not the only) Method for getting out all the *Air*, may be judged by the *boiling* of *Water*, which in its Ebullition does emit a great Quantity of *Air* for a long Space of Time.

The Perfection *of theſe* Barometers, *which exceed all others I have ever obſerved in the following Particulars.*

1. They are ſenſible of the moſt minute Changes of the *Air* whatſoever.

2. They

2. They foretel the Weather by a much longer Space of Time than others, as moſtly 20 Hours, ſometimes 36 or 48 Hours: Nay, before great Tempeſts, and ſuch Rains as cauſe great Floods, for a much longer time before they happen.

3. Although they are ſo ſenſible of ſuch minute Changes of the *Air*, yet the moſt intenſe *Heat* will not *raiſe* them a Hair's-breadth, nor the greateſt *Cold* make them *fall*. This ſhews they are perfect *Barometers*, and not in any degree *Thermometers*.

4. You may by them diſtinguiſh whether, if they ſhew for *Rain*, it will be little or much.

5. As by other *Barometers* you cannot tell the Weather, but by a paſt and a preſent Obſervation; theſe tell you, the Inſtant of Time you come to them, what the Weather is going to be: For by rapping the Caſe with your Finger, if it is going to be fair, or very fair Weather, the *Mercury* will riſe that Moment a 10th of an Inch, or more: But if for *foul*, it will ſcarce make any ſenſible Riſe.

[A.] The Reaſon of this I ſhall explain in the Obſervations at the End, *Page* 249.

I have had one of the Glaſſes by me for 10 Years, and have conſtantly obſerved its Motions, which has very ſeldom failed me in foretelling any conſiderable Change of the Weather.

But as ſome People have ſuch ſtrange Notions, as not judging afterward whether they were told true or falſe, and others may miſs in their Expectations of perfect Certainties, which none can attain to; it will not be improper to make the following

REMARKS.

1. Though you can foretel it will rain on the Morrow, it is impoſſible to tell where that Rain will fall; for as every Shower has Space, *i.e.* Length and Breadth, if it rains in that particular Field, yet it may be fair in the next adjoining: And if in Harveſt, or on a Journey, you proclaim it will rain on the Morrow, ſome will, if it does not fall on their Land, or on his Coat, be ſo ſilly as to ſay the Prediction was falſe.

2. The *Barometer* does only ſhew the Preſſure or Weight of the Atmoſphere, and Inclination of the Air, in and about the Country where it ſtands, and not always in a particular Spot; ſo that in foretelling of great Rains, People are apt to ſay the Indication is falſe, becauſe they have not ſeen or heard of it; when perhaps in a Day or two you will hear, that it did then fall three, four, or may be 10 Miles off. For though the Rain ſhould be over us when the Glaſs fell, yet the Wind, which bloweth where it liſteth, carries the Clouds and Rain with it.

3. It is very hard to diſtinguiſh on the *Mercury*'s falling, whether it will be Rain or high Winds, they equally cauſing the *Mercury* to ſubſide.

4. Of all thoſe who gueſs at the Weather from the Whims of their own Brains, it is obſervable, it is not true one time in Ten, nor do any two of them agree about it.

But from Obſervations on this *Barometer*, it will ſeldom fail you once in 20; ſo it is above 100 to 1 preferable.

5. If from the State of the *Mercury* Yeſterday and this Morning, it be pronounced the next Day will be no Rain, and I look at the Glaſs no more To-day; perhaps Winds may ariſe, and ſo alter the Atmoſphere's Weight, and the Glaſs falls much, it will rain on the Morrow, contrary to what I at firſt expected: Here it is plain, had I ſeen the Glaſs again in the Afternoon, I might have alſo foreſeen the Rain.

Hence it is evident from theſe Remarks, that Judgments are taken on the Weather from *Barometers*, which do not prove ſo; and this begets Opinions in the Vulgar and Ignorant, that there is no Judgment at all to be had from them.

If they could conſider, nothing in Nature is certain, permanent and perfect, neither in ourſelves, or what we do or think; then why do we expect it in the Air? Is it not ſubject to as many Chances, Variations and Mutations? Or why ſhould we expect a Foreknowledge of it abſolutely from the *Barometer*, and that it ſhould force us to underſtand its Meaning infallibly?

If the *Barometer* could only foretel very great and remarkable Changes of the Weather; for Inſtance, in Harveſt-time, that a very great Rain, or perhaps Floods, were coming; the Husbandman would ſtop cutting down his Grain, and ſave ſome of it being ſpoiled by the Wet: Or on a Journey, if I know that if I do not get Home by ſuch a Time, or paſs ſuch Rivers, the Floods will be ſo great as not only to prevent me but endanger my Life: And may be here is a Man's Fortune ſaved, nay his Life, merely from the Indications of the *Barometer*; and who reckons this nothing, deſerves neither.

Do not we reckon a Memory, or a Hiſtory, good, that calls to mind, or notes every valuable or remarkable Event, though not every Tale or trifling Story?

The greateſt Storm that has been in our Days, was *Jan.* 8. 1734-5. On the 5th the *Mercury* began to fall, and on the 8th was a 10th below 28 Inches; which has not been ſeen in this Age, or perhaps ſince *Torricellius*'s Time; thence I could plainly indicate, that it would be the greateſt Flood we ever heard of, or the greateſt Storm we ever felt; the latter of which it proved.

Some Rules *and* Obſervations *for foreknowing the* Weather, *by the* riſing *and* falling *of the* Mercury.

Though riſing always preſages fair, and falling foul Weather, yet there are ſeveral Difficulties and Niceties in making a true Judgment from them, and herein conſiſts the chief part of the Art.

I ſhall not trouble you with the ſeveral Obſervations made by Dr. *Halley*, Dr. *Beal*, Dr. *Derham*, Mr. *Patrick*, and others, though they are moſt of them applicable to this improved *Diagonal Barometer*, by reaſon their Eſteem has cauſed them to be in ſo many Hands, and in moſt Authors on the Subject, and becauſe I have collected them in order to be made publick, at the Requeſt of the Improver of the *Barometer*, Mr. *Orme*, and for his Uſe; which ſome time ſince were put into the Hands of my very worthy Friend Dr. *Deſaguliers*, who is acquainted with Mr. *Orme* and his Glaſſes. I ſhall only inſert here ſome few Obſervations, which I believe may be called Rules, as I have

have deduced them from time to time, in uſing Mr. *Orme*'s Glaſſes, and keeping a Regiſter of the Weather; and ſhall at the End of this Account inſert ſeveral more Obſervations on the Diary of the Weather, now ſent with this, which are not yet digeſted into certain Rules, but may in time, I preſume, by ſome more ſkilful Perſons; or by a longer Series of Obſervations and Regiſters of the Weather, which I deſign to purſue, if Health continue.

Rules *and* Obſervations *for the improved* Diagonal Barometer.

1. This *Barometer* very rarely foretels Thunder, ſeldom falling at all before it, which Mr. *Patrick* obſerves others do.

2. In ſerene and hot Weather, when the *Mercury* is high and riſing, and you have all the poſſible Certainty of fair Weather the next Day, and if there happen to fall great Showers, you may conclude they have been driven upon you by Thunder, though you have heard nothing of it.

3. When the *Mercury* is pretty high, and has fallen to foretel Rain, and it riſes again before the Rain cometh; it indicates there will be but little of it.

4. If the *Mercury* continues falling whilſt it does rain, it ſhews it will rain the next Day.

5. In fair Weather when the *Mercury* has continued high or riſing, if it falls a little To-day about Noon, and towards the Evening riſes again, you muſt expect a ſingle Shower the latter part of the next Day, (or perchance by Noon) and then fair Weather again forward.

6. When the *Mercury* riſes gradually, (about half a 10th perpendicular) and continues ſo to do for

many Days together; you may reaſonably expect a fair Seaſon for as long a time as it was riſing, unleſs ſome Gales of Wind intervene, and eſpecially the SW by S. or thereabouts.

7. When the *Mercury* riſes very faſt, or falls very faſt, neither the fair nor foul Weather it forebodes will continue long.

8. Without knowing how the *Mercury* has ſtood ſome little time before, a true Judgment cannot be given at all times: For ſuppoſe I find it in a riſing Condition, I am apt to think it will be fair; but if it had been higher ſome Hours ago, and fell, there muſt happen a Shower.

[A.] What I promiſed in *Page* 252. to explain, was,

Why the *Mercury* in the *Diagonal Barometer* (if it be for fair Weather) on rapping the Caſe ſeveral times, which jars and makes the *Tube* tremble, will riſe at every Stroke for ſeveral Strokes together, and in all ſometimes a 10th of an Inch, or more, in the perpendicular; may, I preſume, be thus accounted for:

1. There is a Coheſion of the *Mercury* to the *Tube*, which hinders its riſing, and ſuch rapping releaſes that.

2. But it is obſervable, that it will riſe a little at all times, even when it is in a ſtanding or even in a falling Condition. This may be accounted for thus:

The *Mercury* and *Atmoſphere* are in an *Equilibrio*, and rapping ſtarts and raiſes the *Mercury* a little in a boiling manner, eſpecially the upper Surface of it, which is ſeen to leap, or be in a ſwimming Poſture; then the Preſſure of the *Atmoſphere* over-balances the

the remainder of the *Mercury*, and it muſt riſe a little.

Or ſuch violent jarring puts the *Mercury* in a lateral and upward Motion, (for downward it cannot go) which takes off its Gravity, as the Winds leſſen the Preſſure of the Air; therefore it muſt riſe a little.

But then it is obſervable alſo, that if the *Mercury* was in a ſtanding Condition, or falling, ſuch riſing as above, will in a Minute come to the ſame Place again; and even when the *Mercury* is in a riſing Condition, it will, in that Space of Time, fall a little part of that it roſe by ſuch rapping.

This *Barometer* has the *Coruſcations*, as they were obſerved in Mr. *Patrick*'s pendant one; for by rapping the Caſe with the Finger in a dark place, it will emit ſeveral bright Flaſhes, along the empty part of the *Tube*.

This I take to be an Argument that the *Vacuum* is very pure, and the *Mercury* truly purged.

I ſhall not need to ſay any more, having doubtleſs already deſcended to Trifles; only I would add, which I can with Truth and without Vanity affirm, that in all the Affairs of Husbandry, but eſpecially in Harveſt, it has ſeldom failed me in foretelling the Weather ſo well, as to be very advantageous to me for nine Years together; and ſo pleaſing and ſatisfactory at other times, that they who never had one, cannot know the want of it; and thoſe only who have uſed it, are able to know its Uſefulneſs; and that I could not without ſome Reſtraint, and more Reluctancy, be without one of theſe *Barometers*.

H. Beighton.

Col-

Collections from the Diary *of the* Weather *and* Barometer, *in order to ſettle* Rules *for foretelling the* Weather *by the* Barometer.

GREAT STORMS.

Before them the *Mercury* falls three or four Days, and is exceeding low.

1734-5. *Jan.* 4. at Night the *Mercury* at 29.92 Inches.
5. Night 29.66
6. Night 29.2
7. Night 28.1
8. Noon . . . 27.9 Lower than has been known by $\frac{1}{10}$, and the greateſt Storm of Wind ever heard of in this Age, in the South of *England*, as alſo in *France* and *Holland*.

1736. *Jan.* 31. . . . . . . 29.47
Feb. 1. . . . . . . 29.15
2. . . . . 28.39 Rain and Stormy.
1734. *Aug.* 11. Stormy.

GREAT FLOODS.

Before which the *Mercury* falls very much.

1735. *Sept.* 4. . . . . 29.7
5. . . . . 29.6
6. Night 29.6
7. . . . . 29.25 The greateſt Flood that has been (at *Coventry*, being about the

the Middle of *England*) theſe 40 Years, and yet the *Mercury* fell but little.

1735. *Oct.*	23.	29.55	
	24. Night	28.8	
	25. Night	28.78	
	26.	28.85	
	27.	28.26	A great Flood.
1735. *Aug.*	19.	29.3	
	20.	29.28	
	21.	29.3	
	22.	29.2	
	23.	29.2	Stormy, great Rain.
	24.	29.38	Floods.
1735. *Dec.*	2.	29.32	Rain.
	3.	29.5	Fair.
	4.	28.8	Rain.
	5.	28.9	Rain.
	6.	29.5	Fair.
	7.	29.52	Great Rains and Floods.

THUNDER.

The *Mercury* ſeldom falls for Rains that come by Thunder. See Diary, *June* 2. 1735.

THUNDER.

When the *Mercury* did riſe.

1733. *June*	21.	29.16	29.56	
	22.	29.56	29.56	
	23.	29.62	29.65	Hot.

	24.	29.65	29.57 Sultry.
	25.	29.54	29.52 Sultry.
	26.	29.51	29.59 Great Thunder.
	27.	29.57	29.56 A very violent Thunder, from Ten in the Morning to One in the Afternoon, doing great Damages.
1735. *June*	1.	29.3	29.8
	2.	29.4	29.55 Thunder and great Rains.

THUNDER.

The *Mercury* fell before it,

1733. *July*	27.	29.44 hot, fair.
	28.	29.37 Wind, Rain.
	29.	29.09 Violent Thunder.
1734. *Aug.*	7.	29.59 Sultry.
	8.	29.46 Fair.
	9.	29.25 Thunder.
	10.	28.87 Rain. Thunder.

FROST.

A Froſt, when the *Mercury* is high, brings Rain.

1731. *March.* The *Mercury* was high all the Month, and no Rain, but what followed the Froſt on the 17th and 29th.

DRY SEASON.

In *June* 1729. and the *Mercury* ſcarce ever above changeable.

In *Aug.* 1730. the *Mercury* never lower than 29.37.

1731. from the 1ſt to the 10th, and Rain came the 16th, though the *Mercury* was riſing.

FROST.

A great Froſt, although the *Mercury* fell; but it was attended with a great Snow, which might occaſion it to ſubſide.

1731. *Jan.*	1.	29.56		Rain.
	2.	29.46	29.12	Rain.
	3.	28.78	28.72	Wind.
	4.	28.72	28.81	Froſt, great Snow.
	5.	28.93	29.12	Snow, Froſt.

GREAT RAINS.

Although the *Mercury* was riſing,

1732. *May*	1.	29.28	29.25	Wind.
	2.	29.21	29.25	Rain all Day, Snow hard from 8 to 11.
	3.	29.34	29.0	Rain.
	4.	29.09	29.09	Rain.
	5.	29.12	29.34	Wind.
	6.	29.44	29.46	Fair.
	7.	29.52	29.39	Rain and great Floods.

Great Rain, though the *Mercury* fell but little.

1733.	24.	29.6	29.54	Wind.
	25.	29.51	29.54	Fair.
	26.	29.52	29.54	Fair.
	27.	29.5	29.39	Violent Rain for more than 11 Hours.

GREAT RAINS.

The *Mercury* falling very much.

1734. *July*	10.	29.65	29.67	fair, hot.
	11.	29.63	29.62	fair, hot.
	12.	29.59	29.4	Rain.
	13.	29.29	29.13	Great Rains.

——The *Mercury* falling a great while before the Rain came, and the Rain continued as long.

1736. *May*	19.	29.75	fair, Wind,	29.8
	20.	29.8	cold Wind, fair,	29.7
	21.	29.65	cold Wind,	29.52
	22.	29.39	wind,clouds,rain,	29.31
	● 23.	29.28	cloudy, fair,	29.27
	24.	29.32	fair,	29.35
	25.	29.32	clo. Wind, Rain,	29.24
	26.	29.15	Rain,	29.15
	27.	29.12	Rain,	29.2
	28.	29.28	Rain,	29.23
	29.	29.37	Wind, cloudy, Rain.	

1735. *Feb.*	22.	29.43	
	23.	28.82	
	24.	28.9	
	25.	28.76	great Rain.

Juſt after hot or ſultry Weather, the *Mercury* generally falls.

See 16 *Sept.* 1731.
8 *Aug.* 1734.

After the *Aurora Borealis,* there generally follow high Winds.

27 *Oct.* 1733. a large *Aurora Borealis,* and the 28th, 29th and 30th high Winds.
See 23 *Jan.* 1734.

The *Mercury* falling pretty much, and neither Wind nor Rain ſucceeded.
1733, from the 18th to the 21ſt it fell 41, and no Wind or Rain at all till the 25th.

Sultry Weather generally makes the *Mercury* fall ſoon after.
1734. *Aug.* 8.

After a great Storm the *Mercury* riſes very faſt.
1734. *Aug.* 11.
1736. *Feb.* 6.

Before great Winds the *Mercury* falls very ſoon.
1734. *Aug.* 26.
1736. *Feb.* 8.

The *Mercury* below 28 Inches.
1734. *Dec.* 15. at 27.9
1735. *Jan.* 8. 27.9

In Winter, before Froſts, the *Mercury* generally riſes pretty faſt.
1735. *Dec.* 12.

Before a Thaw the *Mercury* falls.
1735. *Dec.* 13.
17.
1736. *Feb.* 9.

The *Mercury* falls ſuddenly before a great Snow,
1731. *Jan.* 4.
1736. *Feb.* 8.
21.

When the *Mercury* falls for high Winds, and it continues to fall when that Wind is come, it is likely to be tempeſtuous, or continue ſome time, unleſs Rain ſucceeds.

1736.	22. *Nov.*	29.62	fair, warm	29.62
	23.	29.49	windy, warm	29.32 wind.
	24.	29.1	high Wind	28.88 28.73 Stormy.

Some of theſe Collections are quite contradictory to any ſettled Rules, and ſuch will happen, and others confirm them; but I have collected ſo very few of a Sort, though the Diary furniſhes a great many, that till more are in this manner collected, it will be very doubtful to form any Rules from them: As Opportunity gives leave, I intend to collect many more.